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(54) SURGICAL PROSTHETIC IMPLANT FOR VERTEBRAE

CHIRURGISCHES PROTHETISCHES WIRBELKÖRPERIMPLANTAT

IMPLANT PROTHETIQUE CHIRURGICAL POUR VERTEBRES

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(56) References cited:
EP-A- 0 517 030
EP-A- 0 577 178
WO-A-90/00037
WO-A-91/06261
US-A- 2 677 369
US-A- 3 867 728
US-A- 4 309 777
US-A- 4 759 766
US-A- 4 834 757
US-A- 4 997 432

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to inert rigid vertebral prosthetic devices and methods for implanting the devices between adjacent vertebrae to treat or prevent back or neck pain in patients with ruptured or degenerated intervertebral discs and for replacing vertebral bodies damaged by fracture, tumor or degenerative process. Specifically, the invention deals with ring-like prosthetic plugs or discs used singly or stacked together between vertebrae to form support struts in the spinal column and having rigid surfaces facilitating anchoring and providing valleys for bone ingrowth from adjoining vertebrae. The rings are bottomed on the opposing end faces of adjoining vertebrae, are preferably oval shaped with medial-lateral and anterior-posterior dimensions in the same ratio as normal vertebral bodies, are supplied in different heights to be used individually to replace a single damaged intervertebral disc, have ridges to bite into the vertebrae or to interdigitate to be securely stacked together to the exact height required at the time of surgery, have slots and hollow areas for packing bone graft material, tool receiving means, and are preferably radiolucent to allow visualization of the bone healing postoperatively.

Description of the Prior Art

[0002] While many types of vertebral prosthetic devices have been proposed, the success ratio has been very low and the surgical procedures have been very complicated and traumatic to the patient. The surgical implant devices and methods covered in my United States Letters Patents 4,743,256, 4,834,757 and 4,878,915 have greatly improved the success rate and have simplified the surgical techniques in interbody vertebral fusion. In the procedures covered by these patents, biologically acceptable but completely inert strut plugs are bottomed in channels or grooves of adjoining vertebrae and receive bone ingrowth which quickly fuses the structure to the bone and forms a living bone bridge across the fusion area.

[0003] In particular, the document US 4,834,757 discloses surgical prosthetic devices including a rigid inner plug sized and shaped to fit opposed end faces of vertebrae in a vertebral column and having top and bottom faces with peaks adapted to bite into the end faces of the adjoining vertebrae and valleys between the peaks to receive bone ingrowth. A central aperture extends through said plug between the top and bottom faces, which is to be packed with bone graft material.

[0004] The preamble of claim 1 is based on the disclosure of said document.

[0005] The document WO 90/00037 discloses an implant structure which comprises a plurality of openings therein for promoting bone ingrowth. The application of the implant is directed to the implantation within the spinal disc space.

[0006] The present invention now further improves this art of interbody fusion without cutting groves or channels in the verebrae and is especially well suited for anterior cervical and lumbar fusion. The problem underlying the invention is to improve the known surgical prosthetic device in such a manner that the healing process can be better controlled and monitored.

[0007] This problem is solved by the surgical prosthetic device of claim 1. The subclaims define preferred embodiments.

[0008] The invention provides ring-like prosthesis plugs or discs bottomed on end faces of adjoining vertebrae and constructed and arranged so that they can be used singly or stacked plurally to accommodate individual surgical requirements. The rings can replace excised discs and vertebrae and can also be mounted inside the fibrous disc column connecting adjoining vertebrae. The annular units are preferably oval or partial oval shaped preferably hemi-oval, to conform with vertebral disc shapes, have ridged or peaked surfaces for biting into the vertebrae on which they are seated and for receiving bone ingrowth in valleys between the peaks. When stacked, an interior connecting bar can be provided to lock the components in fixed relation and cooperate with interfitting ridges.

SUMMARY OF THE INVENTION

[0009] According to this invention, biologically acceptable, but inert rigid annular prosthesis units are provided to support and fuse with adjacent vertebrae in both the cervical, thoracic spine and lumbar portions of a human vertebral column. These ring-like prosthetic devices are bottomed on the hard bone faces or end plates of adjacent vertebrae and are generally oval shaped to conform with the general outline perimeter of the vertebrae. They are also provided in partial (preferably hemi-oval) annular shape to accommodate those surgical procedures where only a portion of the vertebrae or disc is damaged. Two such hemi-oval rings can be used in the posterior lumbar area inside-by-side relation since the dural sac and nerve roots must be retracted to each side in turn as the implant is placed on the opposite side. In an anterior fusion since the entire front of the disc space is exposed, a single piece implant can be used making the oval an advantage in this area.

[0010] The periphery of the oval ring is grooved to accommodate ingrowth of blood capillaries and the open central portion of the ring is preferably packed with bone graft material to facilitate bone ingrowth. Bone graft can also be packed in the grooves.

[0011] Each of the oval implants is sized to match the height of an average disc and thus can vary from 10 to 15mm for the lumbar area and from 7-11mm for the cer-

vical area.

[0012] The oval shape simplifies the surgical procedure since it can be rotated or reversed and still fit the vertebrae. Further, the device stretches the disc tissue creating a tension which will cause the vertebrae to tightly grip the ring on which it is bottomed. If the disc columnar tissue is preserved, a cut, preferably "Z"-shaped, can be made in the columnar fibrous tissue, the interior pulpus material of the disc removed, and the ring implant inserted through the cut to be bottomed on the adjoining vertebrae and surrounded by the disc tissue.

[0013] To accommodate a myriad of different heights between vertebrae on which the prosthesis ring is to be bottomed, the rings can be supplied in sets of different heights to be stacked to the exact height required for a particular surgical implant. For example, in the cervical spine, cervical corpectomy is often required for cervical myelopathies in which large bone spurs cause spinal cord pressure. An average grafting height is 30mm after corpectomy and this can be achieved by stacking, for example, three 10mm high oval implants.

[0014] In the treatment of thora columbar fractures, hemi-corpectomy is often done followed by grafting. Placement of stacked hemi-oval implants in the hemicorpectomy area provides solid structural weight bearing. The re-sected vertebral bone is packed into the implant so that harvesting of additional bone grafting can be avoided.

[0015] In the treatment of vertebral tumors, the stacked oval implants can achieve solid bony fusion across the entire re-sected area providing a permanent mechanically secure repair with living tissue.

[0016] The invention now provides vertebral prosthetic implant devices suitable for anterior, posterior or lateral placement in any area of the spine requiring replacement of disc or vertebral body. Since the implants are intended to bottom out on adjacent vertebral end faces, which preferably have been prepared by flattening with a burr drill, removing cartilaginous material and stretching the annular fibrosis so that the vertebrae can tightly grip the plug, the plugs can be inserted either anteriorly, posteriorly or laterally into the vertebral column while mounted on the end of an insertion tool.

[0017] The ring devices have ridged surfaces providing multiple purposes of gripping the vertebrae to resist expulsion, forming valleys to facilitate bone ingrowth, and to matching interdigitate with each other for stacking.

[0018] An upstanding longitudinal connecting member fits in interior grooves in the ring and cooperates with the ridges to prevent separation of stacked implants in every direction except in longitudinal height. Since the implants are placed in compression between the vertebral bodies, they cannot come apart after implantation.

[0019] The implants are preferably made of radiolucent material such as carbon fiber reinforced polymers known commercially as "Peek", (polyetherether ketone) or "Ultrapek" (polyether ketone, ether ketone, ketone). Alternately, polycarbonate, polyprophylene, polyethelyene and polysulfone type plastics material filled with glass or carbon fibers can be used. Such materials are supplied by ICI Industries of Wilmington, Delaware; Fiber-Rite Corporation of Winona, Minnesota or BASF Corporation.

[0020] Preferred best mode embodiments of the invention are illustrated in the attached drawings in which:

FIG. 1 is a top and side perspective view of a full oval prosthetic device according to this invention;
FIG. 2 is a top and side perspective view of a hemi-oval prosthetic device of this invention;
FIG. 3 is a top and side perspective view of a connecting bar fitting the illustrated grooves in the devices of FIGS. 1 and 2 to hold a plurality of the devices in stacked relation;
FIG. 4 is a top and side perspective view of a stack of the devices of FIG. 1 with the connecting bar of FIG. 3 in place;
FIG. 5 is a top and side perspective view of a stack of the devices of FIG. 2 with a connecting bar like FIG. 3 in place;
FIG. 6 is a view similar to FIG. 1 but illustrating a modified device with an integral cross bar;
FIG. 7 is a side view showing a tapered device of this invention;
FIG. 8 is a side view of the stack of devices of FIG. 4 showing how the ridges interdigitate when stacked;
FIG. 9 is a view similar to FIG. 8 but showing a stack of tapered devices of FIG. 7 with the center device rotated 180° to form a vertical stack with end faces tapered in the same direction.
FIG. 10 is an elevational view of a portion of a vertebrae column showing a two stack assembly in an excised disc space between adjacent vertebrae and the manner in which a disc can be cut to receive a device of this invention.
FIG. 11 is a sectional view along the line XI-XI of FIG. 10;
FIG. 12 is a longitudinal view of a portion of a vertebral column, with parts in section and broken away to show the manner in which a stack of the devices is used to replace partially damaged discs and an intermediate vertebrae portion;
FIG. 13 is side diagrammatic view showing the insertion of a device of this invention in a disc space with the aid of a mounting tool.
FIG. 14 is a view similar to FIG. 13 illustrating the manner in which a forklike tool can have tines mounted in a pair of holes in the device.
FIG. 15 is a line diagram illustrating the manner in which the ridges of the plugs have side walls diverging at the same angles from the peaks to provide interdigitating or complimentary mating or nesting projections.

[0021] As shown on the drawings:

[0022] In FIG. 1, the reference numeral 10 designates generally a vertebrae prosthesis device of this invention composed of rigid biologically acceptable and inactive material, preferably a radiolucent plastics material, inert metal and the like as described above. The device 10 is an oval ring plug 11 generally shaped and sized to conform with the disc space between adjoining vertebrae in a vertebral column. The plug 11 has opposed sides 11a and ends 11b, flat, ridged top and bottom faces 11c and a central upstanding aperture 11d therethrough. The ends 11b have relatively wide and long horizontal peripheral slots 11e therethrough preferably extending into the sides 11a and communicating with the central aperture 11d.

[0023] Ridges 12 are formed longitudinally across the end faces 11c. These ridges 12 have inclined side walls 12a merging at sharp peaks 12b and provide valleys 12c between the side walls. The valleys 12c open at the ends 11b of the oval ring plug 11.

[0024] One side wall 11a of the plug 11 has an internally threaded hole 13 extending partially through the wall for receiving a mounting tool as hereinafter described.

[0025] The interior faces of the side walls 11a also have upstanding open ended vertical grooves 14 preferably of fragmental cylindrical configuration. These grooves are provided for mounting a rectangular connecting bar 15 shown in FIG. 3. This bar 15 has flat side faces 15a, rounded side edges 15b to snugly fit the grooves 14 and top and bottom end edges 15c which are provided with ridges 16 that conform with the ridges 12 of the plug 10. Thus, these ridges 16 have oppositely inclined sides 16a converging to peaks 16b and providing valleys 16c therebetween. The peaks and valleys of the ridges on the ends of the connecting bar 15 are aligned with the peaks and valleys of the ridges on the top and bottom faces 11c of the plug 11 when the bar is seated in place in the grooves 14.

[0026] The connecting bar 15 has a height conforming with the total height of a stack 17 of plugs 11 shown in FIG. 4 or with only a single plug 11 if a stack of plugs is not necessary. As shown in FIG. 4 three plugs 11 are stacked together with the ridges 12 of the intermediate plug nested in and interdigitating with the ridges of top and bottom plugs. These ridges interfit to provide a stable stack and the connecting bar 15 seated in the aligned grooves 14 of the three plugs will prevent shifting of the stack. The end faces of the bars 15 will then have their ridges 16 aligned with the ridges 12 in the exposed end faces of the top and bottom plugs 11.

[0027] The central aperture 11d of each plug 11 is separated by the bar 15 into two side-by-side chambers which are easily packed with bone graft material to expedite the fusion of the prosthesis device in the spinal column. In addition, the slots 11e in the ends 11b of the plugs can receive bone graft material and also provide free spaces for blood flow to speed up the fusion process.

[0028] A modified hemi-oval device 20 is illustrated in FIG. 2 for usage in partial corpectomy operations and also for use in spaced side-by-side relation when an intermediate nerve space is needed. The device 20 is a one-piece plastics material or metal plug 21 of generally hemi-oval shape with opposed side walls 21a, a rounded oval end wall 21b, a flat opposite end wall 21c and a central aperture 21d. The top and bottom faces 21e of the plug 21 are ridged in the same manner as the plug 11 thus providing longitudinal ridges 22 with inclined side walls 22a, peaks 22b and valleys 22c. The end walls 21b and 21c have the same slots 21f as the slots 11e of the plug 11 and an end wall 21a has the same tool receiving recess 23 as the plug 11.

[0029] Internal grooves 24 are provided in the inner faces of the end walls 21b and 21c of the plug 21 to receive a connecting bar such as 15. This bar however will divide the central aperture of the plug 21 in a longitudinal instead of a transverse direction as illustrated for the plugs 11.

[0030] As shown in FIG. 5 the plugs 21 form a stack 25, in the same manner as the plugs 11 in the stack 17 of FIG. 4 with the same type of connecting bar 15.

[0031] The plugs 11 and 21 of FIGS. 1 to 5 may vary in thickness or height to suit conditions and in the stacks of FIGS. 4 and 5, plugs of different thicknesses or heights can be stacked together to provide the desired overall height for each operation. Sets of these plugs may thus be supplied so that the surgeon can easily end up with a stack of the required height to fit the patient. The lengths or heights of the connecting bars 15 can also be varied to suit conditions or can be ground down at the time of the operation to match the stack.

[0032] The ridges on the exposed end faces of the stacks of plugs will bottom on the hard end faces or end plates of adjacent vertebrae and the apices or peaks 21b and 22g of these ridges will firmly engage and bite into these faces to prevent slippage. In addition, the valleys 12c and 22c between the ridges serve as gaps or troughs to freely receive bone ingrowth from the adjacent vertebrae.

[0033] The individual plugs or the stack of plugs can be introduced anteriorly, laterally or posteriorly depending upon conditions and the tool receiving recesses 13 and 23 of the plugs 11 and 21 can thus be positioned to meet the particular type of insertion into the vertebral column.

[0034] Instead of providing a separate bar or plate 15, as shown in FIG. 6, a modified device 30 of this invention is a plug 31 of the same oval shape as the plug 11 of FIGS. 1 and 4 but the reinforcing bar 32 of this plug is integral with its side walls 31a. The hollow interior 23 of the plug 31 is thus bisected by an integral internal partition 32 forming a pair of side-by-side apertures through the plug adapted to receive bone graft material.

[0035] A plug similar to 30 can also be provided in a hemi-oval shape. The plugs with the integral dividing bar

are preferably used singly but also can be stacked and interdigitated by their ridges.

[0036] The plugs 11, 21 and 31 of FIGS. 1, 2 and 6 are uniform in thickness or height across their length.

[0037] In a further modified device 40 shown in FIG. 7, the plug 41 is tapered to be higher or thicker at its anterior end than at its posterior end. The plug 41 has ridged top and bottom faces 42, the same as the plugs of FIGS. 1-6 and a tool receiving recess 43 is provided in its higher or trailing end. By way of an example, the trailing end could be 12mm in height while the leading end reduced to 9mm in height.

[0038] In the stacking of plugs, each of which have uniform height or thickness such as shown at 11, 21, and 31, the holes for the mounting tool can all be aligned on one side of the stack as illustrated in FIG. 8 but, as shown in FIG. 9, the forming of a stack 44 of tapered plugs 41 requires displacement of the central or middle plug 180 from the end plugs in order that the stack will have a vertical column contour. The ridged faces 42 of the tapered plugs 41 will interdigitate and the exposed end faces of these ridges will be inclined or tapered to suit surgical application in spaces where the adjacent vertebrae are wider at one end than at the other. The use of the tapered plugs eliminates some of the grinding of the end faces of the vertebrae that may be needed for a good matching of the ridges with the vertebrae faces.

[0039] As shown in FIG. 10, a portion of a human vertebral column 50 has adjoining vertebrae 51 and 52 fused together by a two-unit stack 53 composed of the plugs 11 illustrated in detail in FIGS. 1, 4 and 8. This stack 53 fits the disc space 54 between the vertebrae 51 and 52 and the top ridges 12 of the stack are bottomed on and bite into the bottom face or hard end plate of the upper vertebrae 51 while the bottom ridges 12 of the stack are bottomed on and bite into the upper face or hand end plate 52a of the lower vertebrae 52. The peaks 12b of the ridges 12 firmly anchor the stack to the vertebrae but do not penetrate through the hard faces 51a and 52a of the vertebrae. The valleys 12c are exposed to the vertebrae faces and receive bone ingrowth from the vertebrae during the post-operative fusion.

[0040] As shown all of the disc has been removed from the disc space 54 and the stack 53 maintains the disc space at its normal height.

[0041] As shown in FIGS. 10 and 11, a vertebral disc 55 fills the disc space 56 between the vertebrae 52 and a lower vertebrae 57 of the vertebral column 50. A Z-shaped cut 58 through the tubular fibrous portion of the disc 55 provides access to the interior pulpus portion of the disc permitting its removal to receive a single plug 11 forming a rigid strut inside of the column of disc fibers 55a which remain attached to the bottom face 52b of the upper vertebrae 52 and the top face 57a of the lower vertebrae 57. As illustrated, the peaks 12b of the ridges 12 on the top and bottom faces of the plug 11 bite into the faces 52b ad 57a and the valleys 12c between the peaks are openly exposed to these faces of the vertebrae.

[0042] As better shown in FIG. 11, the hollow interior 11d and the slots 11e of the plug 11 are packed with bone graft material 58 which can be conveniently harvested from the iliac crests of the patient's pelvic bone.

[0043] FIG. 12 illustrates a cervical portion 60 of a human vertebral column having an upper vertebrae 61, a middle vertebrae 62 and a bottom vertebrae 63 with a stack 25 like FIG. 5 but composed of four plugs 21 implanted to support the column. As shown, the top and bottom vertebrae 63 remain intact while the middle vertebrae 62 has been partially excised. The four hemi-oval plug units 21 are interdigitated together through their ridges 22 and a bar 15 such as shown in FIG. 5 can hold the units in an upright column. Discs 64 and 65 have also been partially excised to receive the stack 25 but their remaining tissue is anchored to their adjacent vertebrae.

[0044] The bottom face 61a of the upper vertebrae 61 and the top face 63a of the bottom vertebrae 63 are partially penetrated by the peaks of the ridges of the top and bottom plugs 21 to function as described above. Also, the hollow interiors of the hemi-oval plugs 21 and their slots 21e are filled with bone graft material 66.

[0045] During surgery, the spinal column is stretched to regain any lost disc space caused by herniation of the discs. This stretches the remaining disc tissue and as illustrated in FIGS. 13 and 14, the plugs of this invention such as the plugs 11 or a stack of the plugs, are inserted into the opened up disc space such as 70 between adjacent vertebrae 71 and 72, either anteriorly, laterally or posteriorly while mounted on a tool 73 having a single end 73a threaded into the internally threaded hole 13 of the plug 11 as illustrated in FIG. 13. Alternately, the plug 11, as illustrated in FIG. 14 may have a pair of side-by-side holes 13a receiving the tine end 74 of a modified tool 75.

[0046] Tools such as 73 and 75 may also be replaced with other gripping tools which do not require mounting apertures in the end faces of the plugs.

[0047] As better shown in the line diagram of FIG. 15 the ridged faces such as 12 of two stacked plugs such as 11 of FIG. 1 have equally inclined side walls 12a diverging from sharp peaks 12b at a relatively wide angle A to prevent formation of thin narrow fingers or teeth that could break off and narrow valleys that could block bone ingrowth. An angle of at least 30-45° is preferred to provide wide ridges and open valleys.

[0048] From the above descriptions, it will understood that this invention now advances the art of vertebral column surgery and provides prosthetic devices used singly or stacked to desired heights, which fit the disc spaces between adjacent vertebrae, bottom on and bite into the vertebrae faces without penetrating the hard surfaces thereof and have ample chambers for ingrowth of blood capillaries and bone graft material to expedite bone ingrowth during a post-operative period. The de-

vices do not require anchoring screws or penetration through the hard faces of the vertebrae and can be mounted inside the vertebral disc or along the side of a partially excised disc, or in the disc space of a completely excised disc.

Claims

1. A surgical prosthetic device adapted for fusing together vertebrae in a vertebral column which includes at least one rigid inert plug (11) having top and bottom faces (11c) with peaks (12b) adapted to bite into the end faces of the adjoining vertebrae and valleys (12c) between the peaks to receive bone ingrowth, and said plug (11) having a height effective to provide a strut between the vertebrae maintaining a desired space, a central aperture (11d) extending through said plug (11) between the top and bottom faces, said aperture in the plug being adapted to be packed with bone graft material (66), **characterized in that** said plug is sized and shaped to at least partially adopt the cross-section of opposed end faces of vertebrae in a vertebral column, wherein (i) said plug has peaks (12b) and valleys (12c) on bone contacting faces (11) only, and (ii) said peaks and valleys of said top and bottom faces (12) of each of said plugs fully mate together when said plugs are used in a stack.

2. A surgical prosthetic device as claimed in claim 1, wherein said plug (11) is of a shape selected from the group consisting of oval and semi-oval rings.

3. A surgical prosthetic device as claimed in one of claims 1 or 2, wherein the interior of said plug (11) is intersected by a bar (15, 32) in parallel to the side walls, perpendicular to the bone contacting faces (11).

4. A surgical prosthetic device as claimed in claim 1, wherein the top and the bottom faces (12) of the plug (11) have diverging equally sloping side walls converging to sharp peaks (12b), and relative wide valleys (12c) between the peaks (12b), and said side walls being adapted to nest together to hold adjacent plugs in alignment.

5. A surgical prosthetic device as claimed in claim 1, wherein said plugs (11) have diametrically opposed internal grooves (14) receiving a connecting bar (15) in parallel to the longitudinal axis of said stack.

6. A surgical prosthetic device according to one of the preceding claims, wherein said plug (11) is composed of a radiolucent plastics material.

7. A surgical prosthetic device according to one of the preceding claims, wherein said plug (41) has an anterior portion higher than a posterior portion to provide a wedging effect when inserted into position between the vertebrae.

8. A surgical prosthetic device according to one of the preceding claims, wherein the internal slots of said prosthetic device are at least partially packed with bone graft material (66).

9. A surgical prosthetic device as claimed in one of the preceding claims, wherein said plug includes a tool mounting means in a peripheral wall of the plug.

10. A surgical prosthetic device as claimed in one of the preceding claims, wherein the peaks (12b) have side walls diverging at an angle of not substantially less than 30°.

Patentansprüche

1. Chirurgische prothetische Vorrichtung, die zum Verbinden von Wirbeln in einer Wirbelsäule angepaßt ist, die mindestens einen festen inerten Stopfen (11) enthält, der obere und untere Flächen (11c) mit Spitzen (12b), die angepaßt sind, um in die Endflächen der angrenzenden Wirbel zu beißen und Tälern (12c) zwischen den Spitzen, um das Einwachsen von Knochen aufzunehmen, aufweist und der Stopfen (11) eine wirksame Höhe aufweist, um eine Stütze zwischen den Wirbeln bereitzustellen, die einen erwünschten Zwischenraum beibehält, eine zentrale Öffnung (11d), die sich durch den Stopfen (11) zwischen den oberen und unteren Flächen erstreckt, wobei die Öffnung in dem Stopfen angepaßt ist, um mit Knochenpfropfinaterial (66) gepackt zu werden, **dadurch gekennzeichnet, daß** der Stopfen zugeschnitten und geformt ist, um wenigstens teilweise den Querschnitt gegenüberliegender Endflächen von Wirbeln in einer Wirbelsäule aufzunehmen, wobei (i) der Stopfen Spitzen (12b) und Täler (11c) allein auf den den Knochen kontaktierenden Flächen (11) aufweist und (ii) die Spitzen und Täler der oberen und unteren Flächen (12) eines jeden Stopfens vollständig miteinander zusammenpassen, wenn die Stopfen in einem Stapel verwendet werden.

2. Chirurgische prothetische Vorrichtung wie in Anspruch 1 beansprucht, bei der der Stopfen (11) von einer Form ist, die aus der Gruppe ausgewählt ist, die aus ovalen und halbovalen Ringen besteht.

3. Chirurgische prothetische Vorrichtung wie in einem der Ansprüche 1 oder 2 beansprucht, bei der das Innere des Stopfens (11) von einem Balken (15,32) parallel zu den Seitenwänden und rechtwinklig zu

den den Knochen kontaktierenden Flächen (11) durchschnitten wird.

4. Chirurgische prothetische Vorrichtung wie in Anspruch 1 beansprucht, bei der die obere und die untere Fläche (12) des Stopfens (11) auseinandergehende, gleich schräg abfallende Seitenwände aufweisen, die zu scharfen Spitzen (12b) und relativ breiten Tälern (12c) zwischen den Spitzen (12b) zusammenlaufen und die Seitenwände angepaßt sind, um ineinander einzugreifen, um angrenzende Stopfen fluchtend zu halten.

5. Chirurgische prothetische Vorrichtung wie in Anspruch 1 beansprucht, bei der die Stopfen (11) diametral gegenüberliegende innere Nuten (14) aufweisen, die einen Verbindungsbalken (15) parallel zur Längsachse des Stapels aufnehmen.

6. Chirurgische prothetische Vorrichtung nach einem der voranstehenden Ansprüche, bei der der Stopfen (11) aus strahlungsdurchlässigem Kunststoffmaterial besteht.

7. Chirurgische prothetische Vorrichtung nach einem der voranstehenden Ansprüche, bei der der Stopfen (41) einen höheren vorderen Bereich als einen hinteren Bereich aufweist, um eine Keilwirkung bereitzustellen, wenn er zwischen die Wirbel in Position eingeführt wird.

8. Chirurgische prothetische Vorrichtung gemäß einem der voranstehenden Ansprüche, bei der die inneren Schlitze der prothetischen Vorrichtung zumindest teilweise mit Knochenpfropfmaterial (66) gepackt sind.

9. Chirurgische prothetische Vorrichtung wie in einem der voranstehenden Ansprüche beansprucht, bei der der Stopfen ein Mittel zur Werkzeugmontage in einer umfänglichen Wand des Stopfens aufweist.

10. Chirurgische prothetische Vorrichtung wie in einem der voranstehenden Ansprüche beansprucht, bei der die Spitzen (12b) Seitenwände aufweisen, die in einem Winkel von nicht wesentlich weniger als 30° auseinandergehen.

Revendications

1. Prothèse chirurgicale adaptée pour faire fusionner ensemble des vertèbres dans une colonne vertébrale qui comprend au moins une broche inerte rigide (11) ayant des faces supérieure et inférieure (11c) avec des pics (12b) adaptés pour venir en prise avec les faces terminales des vertèbres adjacentes et des vallées (12c) entre les pics de manière à recevoir l'implantation osseuse, et ladite broche (11) ayant une hauteur adaptée pour fournir une entretoise entre les vertèbres maintenant un espace souhaité, une ouverture centrale (11d) s'étendant à travers ladite broche (11) entre les faces supérieure et inférieure, ladite ouverture dans la broche étant adaptée pour être remplie de matériau de greffe osseuse (66), **caractérisée en ce que** les dimensions et la forme de ladite broche sont adaptées pour adopter au moins en partie la coupe transversale des faces terminales opposées des vertèbres dans une colonne vertébrale, dans laquelle (i) ladite broche comporte des pics (12b) et des vallées (12c) sur les faces (11) venant en contact avec l'os uniquement, et (ii) lesdits pics et vallées desdites faces supérieure et inférieure (12) de chacune desdites broches s'emboîtent complètement les uns dans les autres lorsque lesdites broches sont utilisées sous la forme d'un empilement.

2. Prothèse chirurgicale selon la revendication 1, dans laquelle ladite broche (11) se présente sous la forme choisie parmi le groupe se composant d'anneaux ovales ou semi-ovales.

3. Prothèse chirurgicale selon la revendication 1 ou la revendication 2, dans laquelle l'intérieur de ladite broche (11) est entrecoupée par une barre (15, 32) en parallèle avec les parois latérales, perpendiculairement aux faces venant en contact avec l'os (11).

4. Prothèse chirurgicale selon la revendication 1, dans laquelle les faces supérieure et inférieure (12) de la broche (11) ayant des parois latérales de même inclinaison convergeant vers des pics (12b), et des vallées correspondantes larges (12c) entre les pics (12b), lesdites parois latérales étant adaptées pour s'emboîter les unes dans les autres de manière à maintenir les broches adjacentes alignées.

5. Prothèse chirurgicale selon la revendication 1, dans laquelle lesdites broches (11) ont des sillons internes diamétralement opposés (14) recevant une barre de liaison (15) de manière parallèle à l'axe longitudinal dudit empilement.

6. Prothèse chirurgicale selon l'une quelconque des revendications précédentes, dans laquelle ladite broche (11) se compose de matériau radio-transparent.

7. Prothèse chirurgicale selon l'une quelconque des revendications précédentes, dans laquelle ladite broche (41) présente une partie antérieure plus haute qu'une partie postérieure de manière à fournir un effet de calage lorsqu'elle est insérée et mise en place entre les vertèbres.

8. Prothèse chirurgicale selon l'une quelconque des revendications précédentes, dans laquelle les fentes internes de ladite prothèse sont au moins partiellement remplies de matériau de greffe osseuse (66).

9. Prothèse chirurgicale selon l'une quelconque des revendications précédentes, dans laquelle ladite broche comprend des moyens d'outils de montage dans une paroi périphérique de la broche.

10. Prothèse chirurgicale selon l'une quelconque des revendications précédentes, dans laquelle les pics (12b) ont des parois latérales s'écartant selon un angle sensiblement supérieur à 30°.

FIG. 1

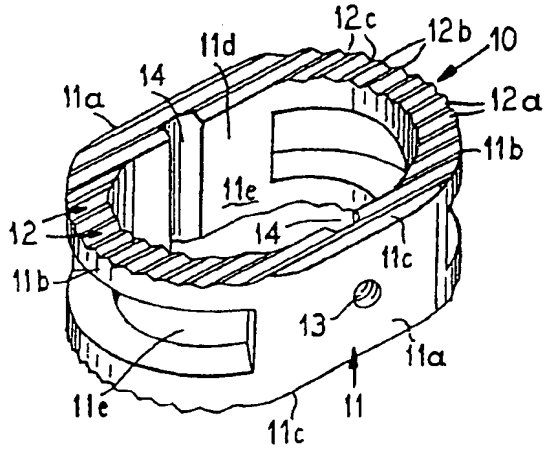

FIG. 2

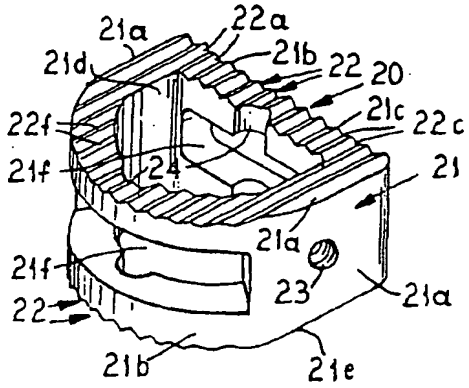

FIG. 3

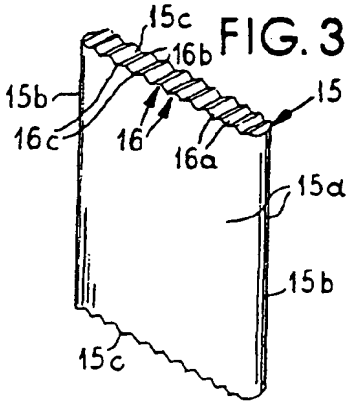

FIG. 4

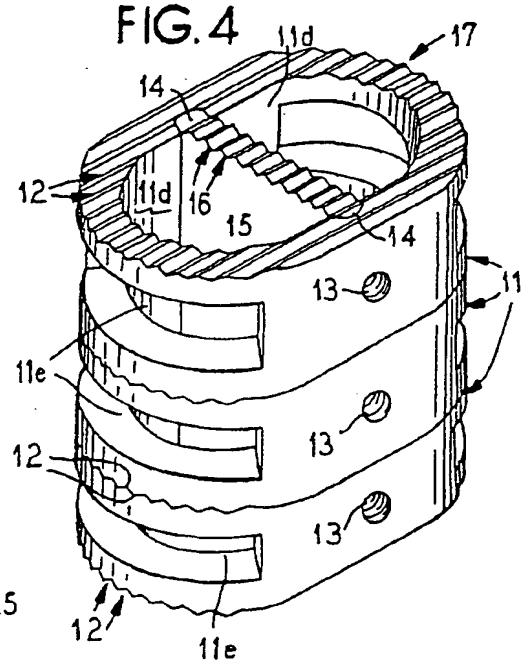

FIG. 5

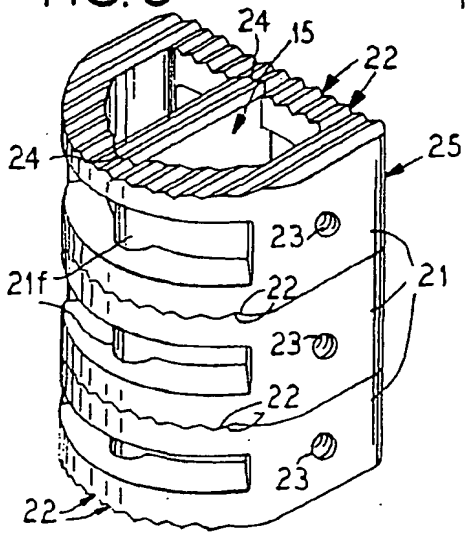

FIG. 6

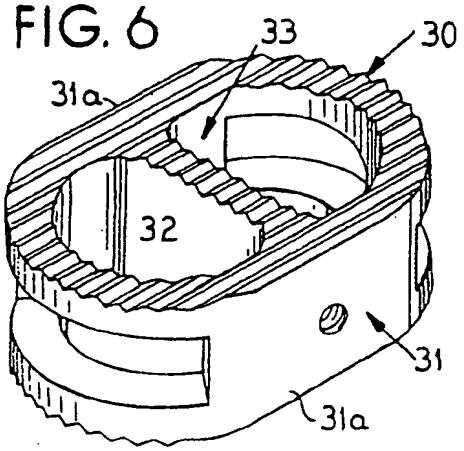

FIG. 8

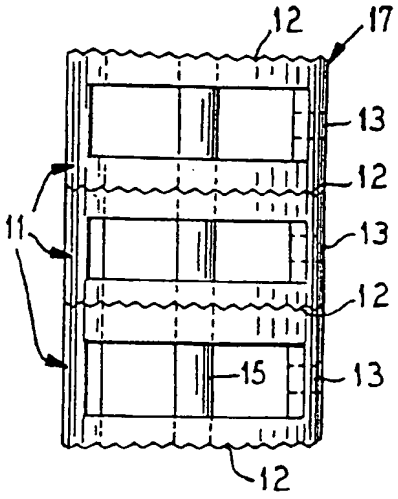

FIG. 7

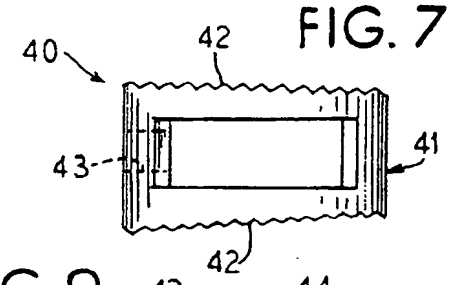

FIG. 9

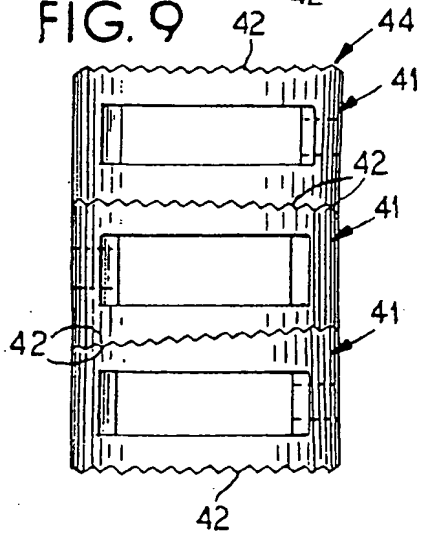

FIG. 10

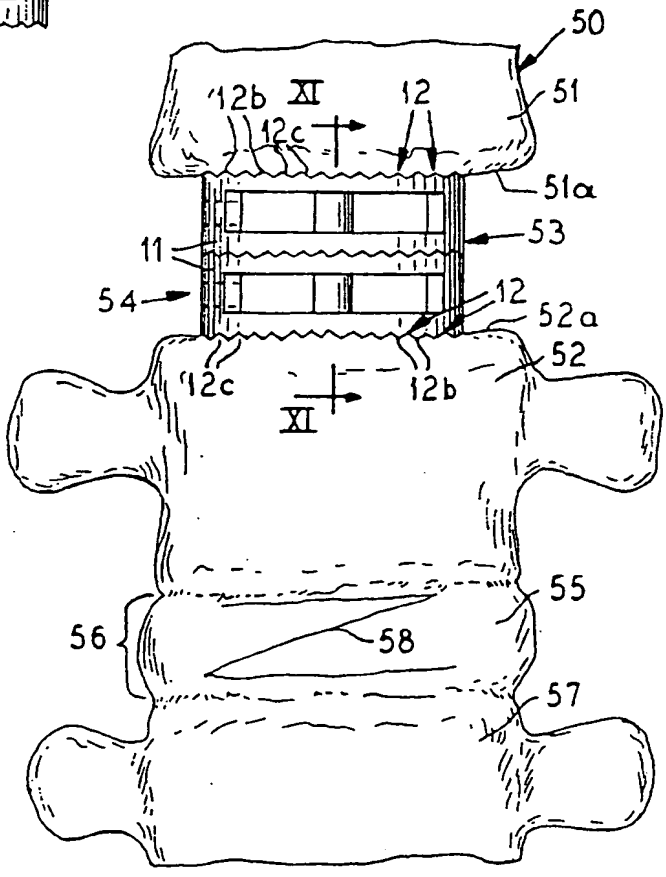

FIG. 11

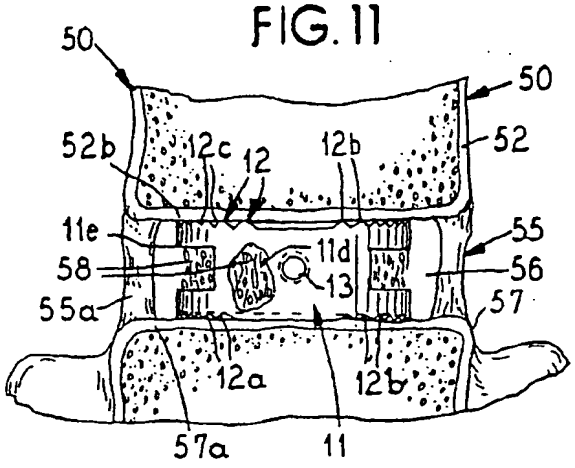

FIG. 12

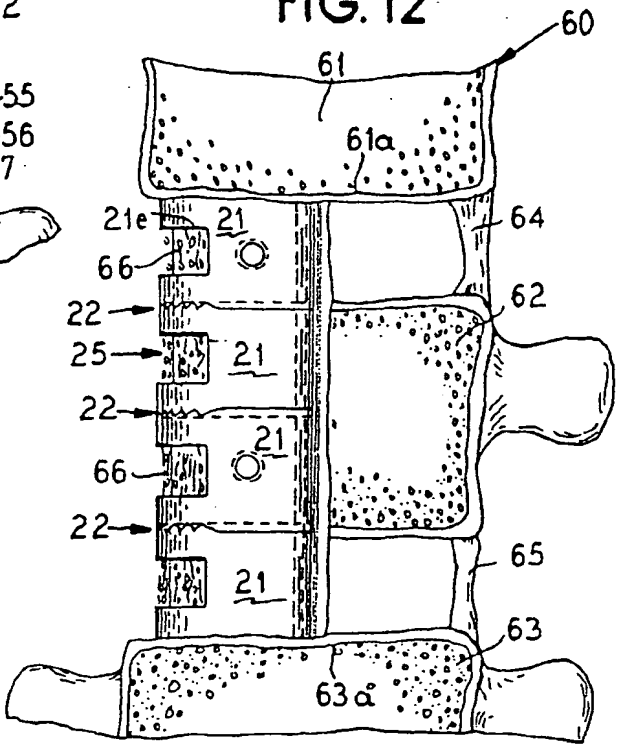

FIG. 15

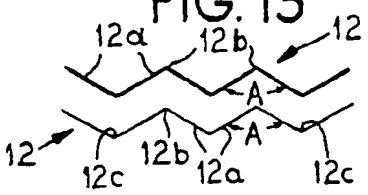

FIG. 13

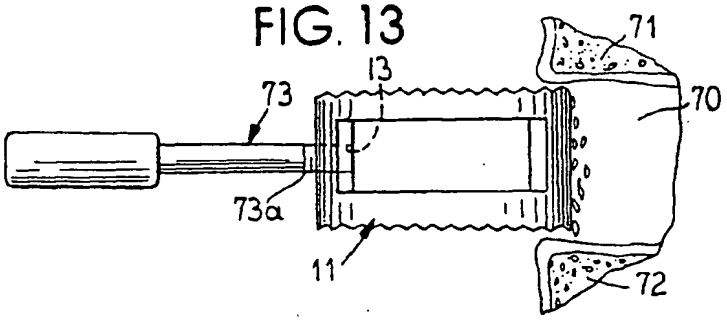

FIG. 14